CLAIMS

We claim:

1. A method to package a holographic filter, comprising the steps of:
recording a grating with a chirp on said filter;
applying a mechanical constraint to said filter; and
altering a thermal expansion of said filter.

2. The method of claim 1 wherein said filter is a simple reflection grating filter.

3. The method of claim 1 wherein said filter is a slanted reflection grating filter.

4. The method of claim 1 wherein said filter is a transmission grating filter.

5. The method of claim 1 wherein said filter is a fixed volume holographic grating filter (VHG).

6. The method of claim 1 wherein said filter is holographically recorded using a phase mask.

7. The method of claim 1 wherein said filter is holographically recorded using a two-beam method.

8. The method of claim 1 wherein said filter is thermally compensated by means of a tube geometry.

9. The method of claim 1 wherein said mechanical constraint further comprising: inducing a strain to tailor a thermal wavelength coefficient of said filter.

10. The method of claim 1 wherein said mechanical constraint further comprising: clamping said filter by a clamp to a pre-set value such that said clamp controls said thermal expansion in a direction of said filter and wherein said thermal wavelength coefficient is modified to be zero.

11. The method of claim 1 wherein said mechanical constraint further comprising: clamping said filter by a clamp to a pre-set value such that said clamp controls said thermal expansion in a direction of said filter and wherein said thermal wavelength coefficient is modified to be non-zero.

12. The method of claim 8 wherein said tube geometry further comprises a plurality of anisotropic tubes to minimize frictional forces along any boundary of said tubes.

13. The method of claim 12 wherein said plurality of anisotropic tubes are generated by wrapping a wire around said filter.

14. The method of claim 13 wherein said wire is not made from a homogenous material.

15. The method of claim 13 wherein said wire has a thickness that is not a fixed thickness.

16. The method of claim 13 wherein said wrapping of wire around said filter forms a layer whose thickness is not a fixed thickness.

17. The method of claim 13 wherein said wrapping of wire has a pitch that is not a fixed pitch.

18. The method of claim 13 wherein said wrapping of wire can be performed at any temperature.

19. The method of claim 12 wherein said plurality of anisotropic tubes are generated by stacking a plurality of washers, each of which have a same inner diameter opening.

20. The method of claim 19 wherein said plurality of washers are held together by a soft solder that physically yields at a low level so that each of said plurality of washers stabilizes and hence prevents a buckling failure.

21. The method of claim 20 wherein said soft solder has a stiffness level less than a stiffness level of each of said plurality of washers.

22. The method of claim 19 wherein a gap between each of said plurality of washers absorbs said thermal expansion such that center of each of said plurality of washers is independent of said thermal expansion.

23. The method of claim 22 wherein each of said plurality of washers have a thickness that is not a fixed thickness and said gap between them is not a fixed gap.

24. The method of claim 9 wherein said thermal wavelength coefficient is modified by a clamp arrangement comprising of a plurality of plates, a plurality of spacers, and a plurality of attaching means such that said filter is placed between a pair of spacers to form a stack which is in turn placed between a pair of plates that are pressed together by said plurality of attaching means at a temperature.

25. The method of claim 24 wherein said plurality of attaching means and said plurality of spacers are each made from a material with a negative expansion coefficient.

26. The method of claim 24 wherein said plurality of plates and said plurality of attaching means both have a first thermal coefficient of expansion and said plurality of spacers have a second thermal coefficient of expansion different from said first thermal coefficient of expansion.

27. The method of claim 26 wherein said first thermal coefficient of expansion is about 16 ppm/°C.

28. The method of claim 26 wherein said second thermal coefficient of expansion is about 0.5 ppm/°C.

29. The method of claim 5 wherein said filter is inserted into a substrate with a lower thermal expansion coefficient.

30. The method of claim 29 wherein said filter has a thermal wavelength coefficient dependant on said thermal expansion coefficient of substrate and said thermal expansion coefficient of filter, stiffness of said filter and stiffness of said substrate, and geometry of said filter and geometry of said substrate.

31. The method of claim 5 wherein said filter is bonded between a first and a second piece of substrate material wherein said first piece of substrate has a thermal expansion coefficient different from a thermal expansion coefficient of said second piece of substrate.

32. The method of claim 1 wherein recording said grating with a chirp is by a fixed amount determined by said filter.

33. The method of claim 1 wherein said package modifies said chirp with a change in temperature.

34. The method of claim 33 wherein said chirp is increased with an increase in said temperature.

35. The method of claim 33 wherein said chirp is increased with a decrease in said temperature.

36. The method of claim 33 wherein said chirp is decreased with an increase in said temperature.

37. The method of claim 33 wherein said chirp is decreased with a decrease in said temperature.

38. A method to package a holographic filter, comprising the steps of:

recording a grating without a chirp on said filter;

applying a mechanical constraint to said filter; and

altering a thermal expansion of said filter.

39. The method of claim 38 wherein said filter is a simple reflection grating filter.

40. The method of claim 38 wherein said filter is a slanted reflection grating filter.

41. The method of claim 38 wherein said filter is a transmission grating filter.

42. The method of claim 38 wherein said filter is a fixed volume holographic grating filter (VHG).

43. The method of claim 38 wherein said filter is holographically recorded using a phase mask.

44. The method of claim 38 wherein said filter is holographically recorded using a two-beam method.

45. The method of claim 38 wherein said filter is thermally compensated by means of a tube geometry.

46. The method of claim 38 wherein said mechanical constraint further comprising: inducing a strain to tailor a thermal wavelength coefficient of said filter.

47. The method of claim 38 wherein said mechanical constraint further comprising: clamping said filter by a clamp to a pre-set value such that said clamp controls said thermal expansion in a direction of said filter and wherein said thermal wavelength coefficient is modified to be zero.

48. The method of claim 38 wherein said mechanical constraint further comprising: clamping said filter by a clamp to a pre-set value such that said clamp controls said thermal expansion in a direction of said filter and wherein said thermal wavelength coefficient is modified to be non-zero.

49. The method of claim 45 wherein said tube geometry further comprises a plurality of anisotropic tubes to minimize frictional forces along any boundary of said tubes.

50. The method of claim 49 wherein said plurality of anisotropic tubes are generated by wrapping a wire around said filter.

51. The method of claim 50 wherein said wire is not made from a homogenous material.

52. The method of claim 50 wherein said wire has a thickness that is not a fixed thickness.

53. The method of claim 50 wherein said wrapping of wire around said filter forms a layer whose thickness is not a fixed thickness.

54. The method of claim 50 wherein said wrapping of wire has a pitch that is not a fixed pitch.

55. The method of claim 50 wherein said wrapping of wire can be performed at any temperature.

56. The method of claim 49 wherein said plurality of anisotropic tubes are generated by stacking a plurality of washers, each of which have a same inner diameter opening.

57. The method of claim 56 wherein said plurality of washers are held together by a soft solder that physically yields at a low level so that each of said plurality of washers stabilizes and hence prevents a buckling failure.

58. The method of claim 57 wherein said soft solder has a stiffness level less than a stiffness level of each of said plurality of washers.

59. The method of claim 56 wherein a gap between each of said plurality of washers absorbs said thermal expansion such that center of each of said plurality of washers is independent of said thermal expansion.

60. The method of claim 59 wherein each of said plurality of washers have a thickness that is not a fixed thickness and said gap between them is not a fixed gap.

61. The method of claim 46 wherein said thermal wavelength coefficient is modified by a clamp arrangement comprising of a plurality of plates, a plurality of spacers, and a plurality of attaching means such that said filter is placed between a pair of spacers to form a stack which is in turn placed between a pair of plates that are pressed together by said plurality of attaching means at a temperature.

62. The method of claim 61 wherein said plurality of attaching means and said plurality of spacers are each made from a material with a negative expansion coefficient.

63. The method of claim 61 wherein said plurality of plates and said plurality of attaching means both have a first thermal coefficient of expansion and said plurality of spacers have a second thermal coefficient of expansion different from said first thermal coefficient of expansion.

64. The method of claim 63 wherein said first thermal coefficient of expansion is about 16 ppm/°C.

65. The method of claim 63 wherein said second thermal coefficient of expansion is about 0.5 ppm/°C.

66. The method of claim 42 wherein said filter is inserted into a substrate with a lower thermal expansion coefficient.

67. The method of claim 66 wherein said filter has a thermal wavelength coefficient dependant on said thermal expansion coefficient of substrate and said thermal expansion

coefficient of filter, stiffness of said filter and stiffness of said substrate, and geometry of said filter and geometry of said substrate.

68. The method of claim 42 wherein said filter is bonded between a first and a second piece of substrate material wherein said first piece of substrate has a thermal expansion coefficient different from a thermal expansion coefficient of said second piece of substrate.

69. The method of claim 38 wherein said package causes said grating to become chirped with a change in temperature.

70. The method of claim 69 wherein said chirp is increased with an increase in said temperature.

71. The method of claim 69 wherein said chirp is increased with a decrease in said temperature.

72. The method of claim 69 wherein said chirp is decreased with an increase in said temperature.

73. The method of claim 69 wherein said chirp is decreased with a decrease in said temperature.